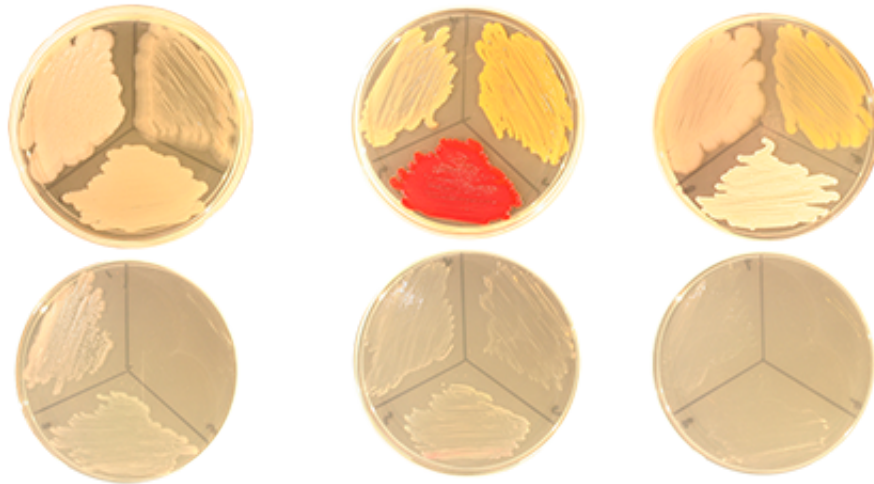


Welcome to BIOC 318, Laboratory Studies in Applied Microbiology

In fall 2016 we significantly revised the content of this course to focus on a single, albeit ambitious, project to characterize the resident flora (primarily bacteria) of a local water source. The changes were very well received and the benefits of the new course design far outweighed the bumps in the road that are inevitable when one makes major changes to an established course design.



Example of some of the work you will conduct in this course. (A) Agar plates with bacterial unknowns, 72h following aerobic incubation at 30°C. (B) Identically streaked agar plates incubated anaerobically for 72h, revealing relationship to oxygen.

Our project

Many studies of samples taken from a wide variety of sources have revealed that between 0.01 and 0.1% of all bacterial cells that can be seen in a light microscope are "uncultivable" in the laboratory.¹ This means that for every bacterial species successfully isolated from an environmental sample, as many as 10,000 species remain undetected. Our project seeks to find and characterize some of this "dark matter" of the microbiome.

¹D'Onofrio, Anthony, Jason M. Crawford, Eric J. Stewart, Kathrin Witt, Ekaterina Gavrish, Slava Epstein, Jon Clardy, and Kim Lewis . "Siderophores from Neighboring Organisms Promote the Growth of Uncultured Bacteria." *Chemistry & Biology* (2010): 254-64.

Our overall project goals are:

- to estimate how many bacterial species can be cultured from an environmental source using conventional methods
- to establish a starting point by identifying and characterizing the "cultivable" species from the source
- to isolate currently "uncultivable" species by (1) applying recently developed published methods and (2) developing and applying methods of our own

Scientists have estimated that up to one trillion microbial species exist on Earth, about 0.001% of which are actually known.² If the one trillion estimate is accurate, then if 100 Rice students *each* discover 100 new species every year (obviously not a realistic expectation), it will take 100 million years to discover all of them. Realistically, we'll be very happy if we discover even one new species or strain of bacteria. Achieving our third project goal, especially part 2, will be challenging, and success is not guaranteed. In fact, most scientific experiments result in failure. What we have to keep in mind is that each step that we take, whether or not it ends in failure, is a step that we will not have to repeat. Even a failed attempt represents progress.

Why pursue this project? What good will it do anyone to discover new species of bacteria? We have no idea. What we do know is that most of the world's greatest discoveries did not come about through targeted research. They came about when scientists (including quite ordinary people like ourselves) asked questions just for the sake of knowing. We have no idea where the next great idea or discovery will come from.

Objectives and learning outcomes

The main goal of this course, as must be true for any experiential course, is personal development. We want you to build on skills that you've already acquired and learn new ones. Below we summarize our most important learning objectives and outcomes.

1. Learn to work as a productive member of a research team on a long term project

²Offord, Catherine. "Earth: Home to 1 Trillion Microbial Species." The Scientist (2016): <http://www.the-scientist.com/?articles.view/articleNo/46016/title/Earth--Home-to-1-Trillion-Microbial-Species/>

2. Be able to access and employ published reference materials, current primary literature, and other information sources in order to advance your understanding of the properties of bacteria and how to isolate and characterize them
3. Learn to integrate your previous and newly acquired experience into development of new techniques and strategies
4. Improve your powers of observation, such as the ability to use physical and metabolic differences to distinguish strains and species of bacteria and to draw information from microscopic observations
5. Learn to make the decisions that are necessary in order to conduct a systematic open-ended investigation
6. Learn to make your work accessible to yourself and others by documenting your activities and findings in a well organized laboratory notebook, by contributing to our laboratory's database, and by summarizing your work in a clearly written report
7. Learn and practice good laboratory "citizenship," including respect for people, the facility, and equipment
8. Acquire proficiency in essential methodologies and use your newly acquired skills to advance our project
9. Learn to appreciate the value and potential of pure science, that is, the pursuit of knowledge for its own sake

Please see the Syllabus for course details, course timetable, and a list of assignments with due dates.

Course Syllabus

Welcome again to BIOC 318. On the home page you will find a brief introduction to the course and a description of the overall course objectives and expected learning outcomes. In addition, please look over the following information about the course, instructors, and policies. Following the course policies is a complete timetable of scheduled activities and assignments with dates, times, and locations when applicable.

The information contained in this syllabus and related pages may be subject to change, with reasonable notice, at the discretion of the instructor.

Instructors and office hours

David Caprette, Teaching Professor

ABL 327 – third floor Anderson Biological laboratory Building

caprette@rice.edu, 713-348-3498 (campus extension 3498)

Office hours are variable (see [HERE](#) for a current schedule)

Charles Stewart, Professor of Biochemistry
GBH W104
crs@rice.edu, 713-348-4926 (campus extension 4926)
Office hours TBD

Preparing for the course

Please plan to apply the skills and best practices that you learned in Bioc 211, Intermediate Experimental Biosciences (course prerequisite) and in Bioc 311, Advanced Experimental Biosciences, if you have had the opportunity to complete that course. Please check the Course Schedule (below), review the meeting schedule for your lab section, and block out the scheduled times on your calendar. You must not schedule events that conflict with any of the listed in-lab activities, nor let anyone schedule a conflicting event for you.

Required materials

You will need eye protection for this course, consisting of a pair of lab goggles or laboratory safety glasses with side protection. A lab coat will be provided. There is no textbook but you will need to obtain a laboratory notebook. You are welcome to start with a partly filled notebook from another course, even one obtained from another student. New notebooks can be purchased from the campus store or ordered directly from the distributor. Please purchase a Hayden-McNeil Carbonless TOP Permanent Lab Notebook, 50 Set or 100 Set from Amazon, from WH Freeman, or the Campus store (ISBNs below).

Chemistry Top Bound 100 pages, ISBN 978-1-930882-00-3
or

Chemistry Top Bound 50 pages, ISBN 978-1-930882-50-8

Course timetable

All meetings begin at 1 pm unless otherwise noted. All meetings will be held in ABL 127. Documents to help you prepare for lab (listed under the heading "Preparation" below) can be found in Files.

To print a file, download it first then print as usual. Attempting to print directly from a Canvas window may not work.

Dates	Preparation	Description of activities
Weds-Thurs Feb 21-22, 1:00 pm	- Review the course home page in Canvas and this syllabus and have questions ready - Review the documents "Aseptic technique," "Making serial dilutions," and "Preparing spread plates," and be prepared for a quiz on the material; all documents are in Files	- Introductory classroom meeting - Short quiz, lab tour, workshop on preparing agar plates, and practice sessions for dilutions and spreading plates
Mon-Tues Feb 26-27	- Review the documents "Isolating colonies" and "Colony morphology;" be prepared for a brief quiz - Peruse the document "Culture media;" you will not be quizzed on this material	- Prepare agar media and pour plates to be used for isolating colonies - Dilute and spread water samples - Practice sessions on isolating colonies and making streak plates
Weds Feb 28 - Thurs Mar 1	Review the document "Agar slant tubes"	- Prepare agar media for slant tubes - Identify and describe unique colonies on spread plates, streak out onto fresh agar plates
Mon-Tues Mar 5-6	Review the documents "Gram stain," and "Relationship to oxygen," and be prepared for a short quiz	- Consolidate isolates and assign isolates to teams - Conduct anaerobic incubations - Practice making Gram stains (Tues section) Gram stain isolates on aerobically incubated plates from the Monday group
Weds-Thurs Mar 7-8	- Again review the document "Relationship to oxygen" - Peruse the document "Using inoculating sticks;" you may prefer this technique over the technique that employs a flame and inoculating loop	- Evaluate anaerobically incubated plates for growth - Inoculate agar slant tubes for storing isolates over the break - Conduct catalase, oxidase tests (Weds section) Gram stain isolates on aerobically incubated plates from the Tuesday group - Learn microscopic observation of living bacteria, record observations on your isolates - Assemble/turn in notebook pages for mid-course eval

SPRING BREAK		
Mon-Tues Mar 19-20	- Review the document "Using Bergey's manuals" - As you work with the microscope you may want to consult the document "Viewing Gram stains," which includes a step by step guide to using our Leica compound microscopes	- Learn microscopic examination of Gram stains, examine Gram stains of your isolates that were prepared before the break and record observations - Sign out a Bergey's manual - In teams, begin to assign isolates to Bergey's "Groups"
Weds Mar 21 and on...	- Enter observations for your isolates into the spreadsheet in Google Sheets - Continue to assign isolates to Bergey's Groups, using recorded observations and in consultation with team members - Guided by Bergey's tables, plan strategies for identifying isolates - Peruse the following resources as needed: "Assays" and "Assays illustrated"	- Conduct additional observations and assays as needed to identify one selected isolate, per team member, to the species level - In teams, plan one or more strategies for isolating rare/uncultivable species from a water sample
- Following the guidelines in "Characterization writeup," each individual is to write up a complete characterization of one isolate – upload into Canvas or submit a hard copy on or before Friday Apr 20. - Prepare a proposal for a strategy to isolate rare and/or "uncultivable" bacteria from our water source, as described in the document "Project proposal guidelines." You may submit your proposal(s) as a team or may split up into partners or even work individually if you wish. Upload the assignment to Canvas or submit a hard copy on or before Friday Apr 27.		

Course grade

Your grade will be based upon your preparation and lab performance (20%), self reliance and contribution to team efforts (10%), laboratory notebook (20%), a monograph on a single bacterial species that you isolate and characterize (25%), and a team-written strategy for isolating rare & difficult to cultivate bacteria (25%).

Additional information and policies

Absences. Because the work in this course is part of a long term goal-oriented project, the concept of a "make-up lab" does not apply. Missing an important event is a lost opportunity that cannot be made up. As far as your course grade is concerned, absences from required meetings will be excused for the usual reasons, e.g., illness or family emergency. Absences due to circumstances within a student's control (e.g., forgetting to show up or travel for interviews) cannot be excused and will be reflected in the performance grade.

Lab safety. All participants must engage in safe laboratory practices and abide by specific "rules" set down for this course.

Late assignments. An assignment that is submitted late will lose 10% per day including holidays and weekends.

Honor code policy. As with all biosciences courses, the Rice University Honor Code applies to all personal conduct and assignments. All work submitted under your name must be your own work, not copied from another source nor completed with unauthorized assistance. Compliance with the honor code includes providing accurate information when requested, such as honest evaluations of yourself and your teammates.

Students with disabilities. Any student with a disability needing academic adjustments or accommodations should contact Dr. Caprette or Dr. Stewart as soon as possible and also contact Disabled Student Services in the Ley Student Center.